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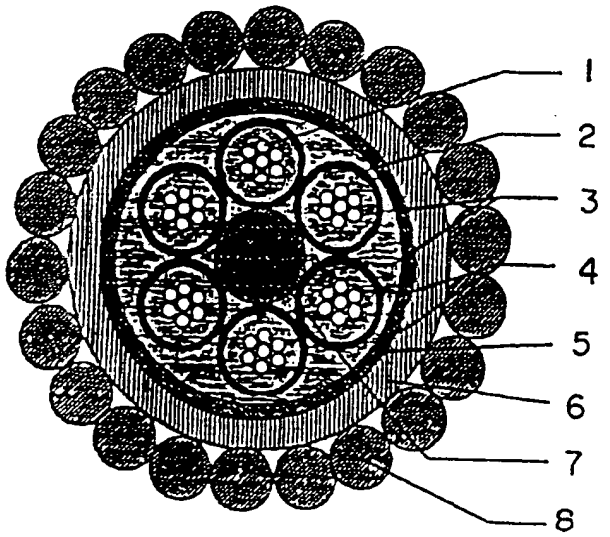
(54) Title: HIGH MECHANICAL AND HEAT PERFORMANCE OPTICAL CABLE

(57) Abstract

It refers to a high mechanical and heat performance optical cable for aerial or underground applications, comprising optical fibers (1) housed with a dimensional clearance inside the protection polymeric tubes (2), having a filling (3), an external sheath (6), metallic elements (8), characterized by the fact of the protection tubes (2) being assembled around the central element (7) of dielectric material, on a helicoid stucture, via fastenings of polymeric wires and binding (4) with helicoid shaped polymeric tapes, also having a peripheral pulling element (5), an external sheath (6) flame resistant and metallic elements (8) helically applied forming and external ring.



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HIGH MECHANICAL AND HEAT PERFORMANCE OPTICAL CABLE.

The present invention refers to an optical cable, preferably for aerial application, however it can also be used underground and has a high mechanical and heat performance because of its constructive features.

The application of optical cables in aerial networks consists of the installation in electrical power distribution networks of medium and low tension or in its own pole line, in urban and rural areas. In rural areas accidents frequently occur with optical cables, because of fire caused by natural or forced burning of the local vegetation and also caused by hunter's shots.

Another important aspect of aerial optical cables are the installation conditions, i.e., maximum distance between poles and sag, climatic conditions, etc., which must be seriously taken into account.

Therefore, an object in the design of aerial optical cables is to meet the mentioned installation conditions, as well as, when necessary, withstand the heat conditions caused by the mentioned fires or the mechanical damage caused by the hunter's guns, without damaging the fibers or altering their optical characteristics.

In the market there are different types of totally dielectric aerial optical cables, which have several advantages over the traditional solutions of metallically sheathed cables, which use corrugated or smooth aluminium or steel tapes. However, principally from the resistance point of view against the fires and gun shots, the dielectric solutions show a low performance and complexity in the production process.

Further, the construction of totally dielectric aerial optical cables, to be installed with large spans, requires a great number of textile pull elements so as to resist the mechanical stress in the

climatic and more critical installation conditions (e.g. maximum wind force, minimum temperature, etc.). This excessive number of textile elements, as well as offering difficulties in the cable's manufacturing cycle, it increases the unit weight as well as the cable's outside diameter, making its dimensions more critical.

An alternative of high efficiency and proven through various practical applications, is the use of lightning conductors optical cables (OPGW). These OPGW cables have exceptional optical and mechanical characteristics, since they have around their dielectric nucleus, where the optical fibers are housed, an aluminium tube and over it one or more layers of metallic wires.

These cables are preferably indicated for new aerial installations in power transmission lines or replacing conventional lightning conductor cable, offering one of the highest security coefficients against accidents caused by different factors, including fire and gun shot.

These cables also have been used in distribution networks or their own pole lines, to take advantages of their exceptional optical and mechanical features. However, for these installations, this alternative is not always the best solution from the economical point of view.

As a result, the present invention provides an alternative which is technically and economically viable of an aerial optical cable project, so as to assure that the mentioned optical cable works according to the project's conditions and, therefore, guaranteeing the mechanical and optical integrity of the optical fibers, within the foreseen mechanical stress and temperature limits. It also shows a better performance regarding heat requirements caused by fires, as well as the impacts caused by gun shots.

To better understand the present invention,

it will now be explained based on the attached drawing, which is an embodiment of the mentioned optical cable.

There are various structures used to house and protect the optical fibers, forming the optical cable nucleus. One of the structures most used is called loose tube type structure or fibers loose within a tube.

One or more optical fibers 1 are housed inside a polymeric tube 2, which has a dimensional clearance in relation with the optical fiber beam 1, that will result in a cross free play of the fibers.

The dimensions of this tube 2 and the relative length of fiber 1 in its interior, in relation with the length of the tube 2, are parameters which are estimated so as to meet the requirements of the lengthening and contraction of the optical cable.

To form the optical nucleus, these tubes are gathered on a central element 7, which can be manufactured of various materials and, usually, work as the strengthening member or mechanical support. When the optical cable has metallic elements on its outside, these central elements 7 must be of dielectric material, in order to avoid electrical discharges. The gathering of the tubes 2 on the mentioned central elements 7 can be screw-shaped, forming an open or close propeller, this technique is called SZ gathering.

This screw-shaped structure gives the fibers 1 a radial movement margin, because of the lengthenings or contractions of the optical cable.

On the tube structure 2 gathered around the central element 7, usually polymeric wire fastenings and binding 4 with polymeric tapes, also screw-shaped, are used and they assure stability of the structure and the linking of the tubes 2 to the said central element 7.

To protect the fibers from contact with humidity, the loose tubes 2 and the interstitial areas 3

are filled with a viscous polymeric gel. However, the present invention also provides the use of a dry nucleus, i.e., with no gel filling in the interstitial area 3 of the loose tubes 2, which are still kept filled so as to protect the optical fibers 1.

In this case, to protect the optical nucleus, against water penetration and spreading in these interstitial areas 3, it is an object of the present invention to use water superabsorbent elements. These materia can be used on the central element 7 and on the gathered tubes 2, in order to block all the possible routes. One of the ways of use, which must not be considered the only one, is the use of a longitudinal wire applied on the central element 7, positioned under the gathered tubes 2, and a tape helically applied on the optical nucleus.

One of the advantages of having a dry nucleus is minimizing the weight of the cable, as well as the internal pressure caused by the filling gel, originated by the increase in temperature, in the possible situations in which this occurs.

To offer better features regarding mechanical traction, these cables can be reinforced by the use of elements such as high pull textile wires, which are strung over the optical nucleus or laid longitudinally on the sheath.

As an external protection for this central nucleus, called the cable's optical nucleus, additional protections are applied which can only be dielectric of polymeric materials, metallic or compounds of metallic (typically aluminium or steel) and polymeric material. Each type of material or compound is used to offer specific features to the cables for specific applications.

In the present invention, the optical cable nucleus is totally dielectric, being coated by one or more

layers of polymeric material and the outermost is flame resistant. Further it is possible to use heat resistant material bindings, such as polyaramide or fiber glass tapes.

To attain a better performance of the cable under fire and heat requirements, as well as against impacts caused by guns, according to the above mentioned, the present invention provides the application over this flame resistant coated nucleus of metallic elements 8 helically applied, forming an external ring.

These metallic elements can be manufactured of various materials, such as aluminium, steel, aluminium coated steel (alclad), etc., and can have various shapes, such as cylindrical, rectangular, trapezoidal, etc.

When this metallic frame is applied on the coated nucleus, techniques can be used to assure its better adhesion on the polymeric coating, amongst them the use of adhesives or heat process can be mentioned.

The said metallic frame is preferably also responsible for the cable's mechanical support in the most critical conditions of installation and climatic conditions, in order to optimize the design, from the cost/benefit point of view.

The use of this optical cable in aerial networks, does not have any kind of special requirement during the installation and operational phases, therefore, it is an efficient alternative for the available solutions.

The present invention also can be applied in underground installation, inside tubing or directly buried, having as an advantage an effective protection against the attack from rodents, a typical problem of dielectric cables.

Although the preferred embodiments of the present invention have been described and illustrated, it is obvious to those specialized in the art that several

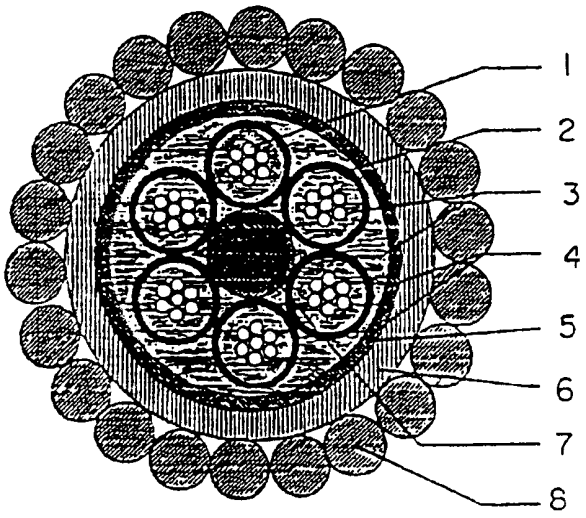
modifications can be applied without forgetting the principles of the invention.

CLAIMS

1. A high mechanical and heat performance optical cable for aerial or underground applications, comprising optical fibers (1) housed with a dimensional clearance inside the protection polymeric tubes (2), having a filling (3), an external sheath (6), metallic elements (8), characterized by the fact of the protection tubes (2) being assembled around the central element (7) of dielectric material, on a helicoid structure, via fastenings of polymeric wires and binding (4) with helicoid shaped polymeric tapes, also having a peripheral pulling element (5), an external sheath (6) flame resistant and metallic elements (8) helically applied forming an external ring.

2. An optical cable according to claim 1, characterized by also providing the use of water superabsorbent elements in the interstitial areas (3) forming a dry nucleus.

3. An optical cable according to claim 1, characterized by providing the use of heat resistant material in the binding (4) such as polyaramide or fiber glass tapes.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INTERNATIONAL SEARCH REPORT

International application No.
PCT/BR 97/00041

A. CLASSIFICATION OF SUBJECT MATTER

IPC^6: G 02 B 6/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC^6: G 02 B 6/44

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 528 653 A1 (AMERICAN TELEPHONE AND TELEGRAPH COMP.) 24 February 1993 (24.02.93), page 3, line 13 - page 4, line 42.	1,2
A	EP 0 613 033 A1 (AT&T LTD.) 31 August 1994 (31.08.94), column 3, line 22 - column 4, line 2; column 7, line 33 - column 8, line 56.	1,3
A	EP 0 632 301 A1 (PIRELLI CAVI) 04 January 1995 (04.01.95), fig. 1-4.	1,2

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
06 November 1997 (06.11.97)	20 November 1997 (20.11.97)
Name and mailing address of the ISA/ AT AUSTRIAN PATENT OFFICE Kohlmarkt 8-10 A-1014 Vienna Facsimile No. 1/53424/535	Authorized officer Gronau Telephone No. 1/53424/348

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Information on patent family members

International application No.
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